Isotropy

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(Redirected from Isotropic)

Isotropy (the opposite of anisotropy) is the property of being independent of direction. Isotropic radiation has the same intensity regardless of the direction of measurement, and an isotropic field exerts the same action regardless of how the test particle is oriented.

- Within mathematics, *Isotropy* has a few different meanings:
    - Isotropic manifolds: Some manifolds are isotropic, meaning that the geometry on the manifold is the same regardless of direction. A similar concept is homogeneity. A manifold can be homogeneous without being isotropic. But if it is inhomogeneous, it is necessarily anisotropic.
    - Isotropic quadratic form: A quadratic form q is said to be isotropic if there is a non-zero vector v such that $q(v)=0$.
    - Isotropic coordinates on an Isotropic chart for Lorentzian manifolds.

- *Cosmology*: The Big Bang theory of the evolution of the observable universe assumes that space is isotropic. It also assumes that space is homogeneous. These two assumptions together are known as the Cosmological Principle. As of 2006, the observations suggest that, on distance scales much larger than galaxies, galaxy clusters are "Great" features, but small compared to so-called multi-verse scenarios; the Cosmological Principle is a good assumption.

- *Cell biology*: If the properties of the cell wall are more or less the same everywhere, it is said to be isotropic. The interior of the cell is anisotropic due to intracellular organelles.

- *Radio broadcasting*: In radio, an isotropic antenna is an idealized "radiating element" used as a reference; an antenna that broadcasts power equally (calculated by the Poynting vector) in all directions. In practice, an isotropic antenna cannot exist, as equal radiation in all directions would be a violation of the Helmholtz wave equation. The gain of an arbitrary antenna is usually reported in decibels relative to an isotropic antenna, and is expressed as dBi or dB(i).

- *Physiology*: In skeletal muscle cells (a.k.a. muscle fibers), the term "isotropic" refers to the light bands (I bands) that contribute to the striated pattern of the cells.

- *Materials*: In the study of mechanical properties of materials, "isotropic" means having identical values of a property in all crystallographic directions.

- *Optics*: Optical isotropy means having the same optical properties in all directions. The individual reflectance or transmittance of the domains is averaged if the macroscopic reflectance or transmittance is to be calculated. This can be verified simply by investigating, e.g., a polycrystalline material under a polarizing microscope having the polarizers crossed: If the crystallites are larger than the resolution limit, they will be visible.

- *Microfabrication*: In industrial processes, such as etching steps, isotropic means that the process proceeds at the same rate, regardless of direction. Simple chemical reaction and removal of a substrate by an acid, a solvent or a reactive gas is often very close to isotropic. Conversely, anisotropic means that the attack rate of the substrate is higher in a certain direction. Anisotropic etch processes, where vertical etch-rate is high, but lateral etch-rate is very small are essential processes in microfabrication of integrated circuits and MEMS devices.

See also

- Rotational invariance
- Isotropic bands
- Isotropic coordinates

Category: Orientation